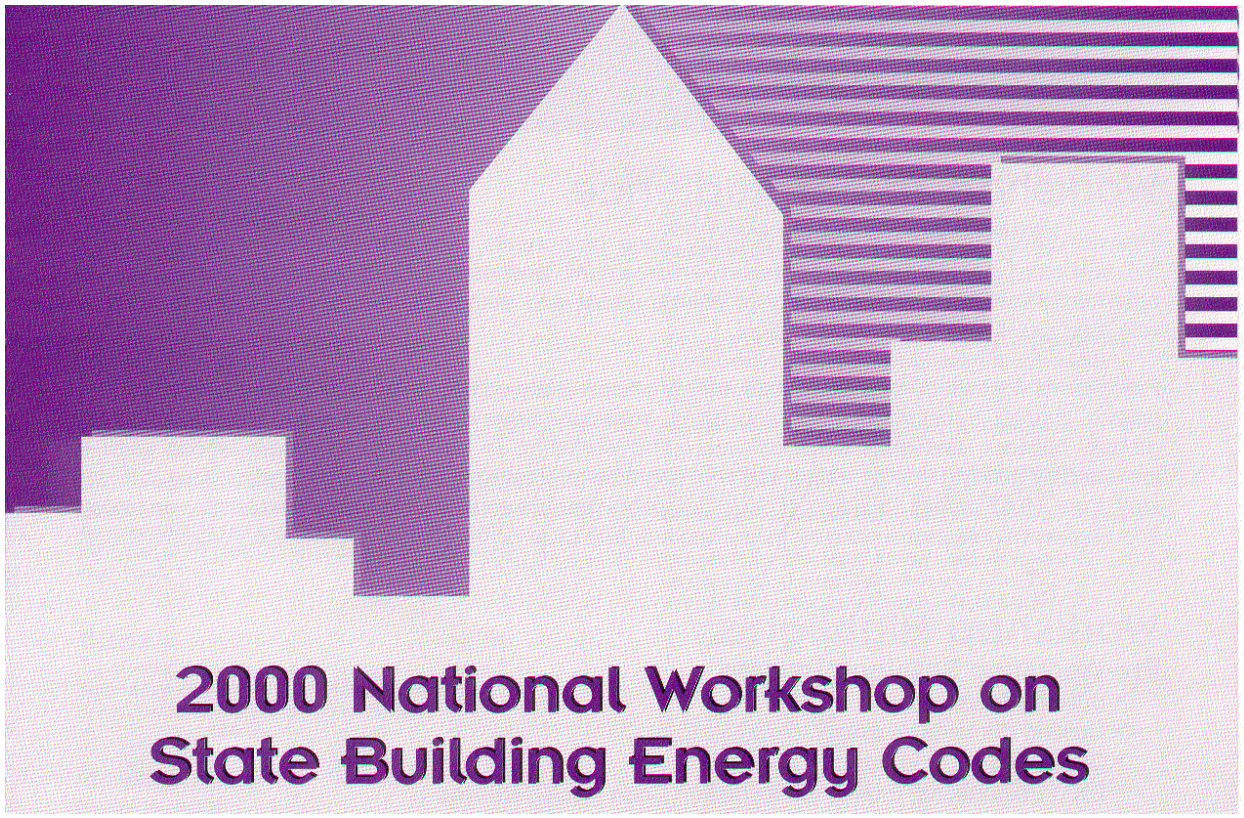


Building Commissioning

Keithly
Welsh
Associates, Inc.

Overview

- Introduction
- Definition of Commissioning
- Integrating Commissioning into the Construction Process
- Recent Code Changes in Washington State
- Commissioning Findings

About Keithly Welsh Associates

- Established in 1996.
- Primarily commissioning & diagnostics.
- Unique focus on the owner's perspective.
- Staff has decades of facilities engineering, construction and maintenance experience.
- Dozens of successful commissioning projects of various sizes and types.
- Extensive school and university experience.

About the Presenter - Bryan Welsh, P.E.

- Licensed Mechanical Engineer with 18+ years engineering and facility engineering experience in commercial, industrial and educational facility environment.
- Extensive school facility experience.
- Successfully commissioned dozens of new and remodeled facilities.
- Retro-commissioning experience.

What is “Commissioning”?

“Commissioning is a systematic and documented process of ensuring that specific building systems perform interactively according to the design intent and the owner’s operational needs.”

Benefits of Commissioning

- Reduced utility consumption and operational costs.
- Smooth transition to M&O.
- Reduced occupant complaints.
- Reduced IAQ problems.
- The darn thing works the way it is supposed to.

Integrating Commissioning into the Construction Process

- Include the commissioning consultant in the design development process.
- Identify systems appropriate for commissioning.
- Define the roles and responsibilities of all project team members in the commissioning process.
- Include a commissioning specification in the project documents.

Commissioning Process

CX3.EDG

Develop Commissioning Specifications

- Important to get into project documents before bidding.
- Outlines the formal commissioning plan.
- Informs the contractors regarding their specific requirements to participate in the commissioning process.
- Provides contractor “checklists” to insure the contractors are prepared for Cx.

Division 1 - 01810 Commissioning General Provisions

- Defines commissioning process and the role of various team members.
- Should be referenced in Part 1, Related Sections, for each section that requires commissioning.
- Contains reference to sections to be commissioned.

Divisions to be Commissioned

- Use xx995 section, for example 15995, Mechanical Systems Commissioning.
- Contains detailed commissioning requirements and any required start-up or pre-commissioning check lists.
- Should be referenced in Part 1, Related Sections, for each section that requires commissioning.
- Contains reference to sections to be commissioned.

Design Review

- Schematic, DD and final construction.
- Constructability and maintainability issues.
- Conflicts between specifications and drawings.
- Focus on mechanical systems, controls and sequence of operations.
- Design review report.

Develop Commissioning Plan

- The “guidebook” for the commissioning process.
- Easy to follow format with repeatable procedures.
- Comprehensive; covers all possible system modes and conditions.

Contractor Pre-Cx Forms

- Lets contractor know what is expected of them in the commissioning process.

- Tool to assure commissioning agent that systems are complete and ready to perform functional tests.

Section 15300 – Fire Protection Systems
Contractors Pre-Commissioning Checklist

Instructions:

Contractor shall check off items on this list as they are completed and return the signed form through the proper channels when all items are complete. The functional performance testing phase of the commissioning process cannot proceed until this checklist is received by the commissioning consultant. In addition, the contractor may be required to demonstrate compliance with specified criteria on-site, as deemed appropriate by the commissioning consultant.

Start-Up/Tests Requiring Commissioning Consultant Witness:

The following start-up or testing activities are to be witnessed by the commissioning consultant. Contractor is to notify commissioning consultant at least 3 days prior to the activity for items listed below.

1. Fire sprinkler trip and acceptance test performed for final acceptance and tagging.
2. Supervisory circuit testing.

Pre-Commissioning Check List:

[ ] Commissioning agent notified of testing date.

[ ] Approved shop drawings have been received from AHJ(city of Tacoma) and submitted to the project team.

[ ] Water supply engineering tests have been performed and approved by AHJ and results submitted to the project team.

[ ] Piping is complete, flushed, tested and approved by AHJ per Section 15300, 3.05 and results submitted to the project team.

[ ] Double detector check valve is complete, tested and test report submitted to AHJ and project team.

[ ] Wet valves, dry valves, post indicator valves, flow switches, tamper switches, alarm gongs, air compressor and any associated equipment are complete, tested, tagged and approved in writing by the AHJ.

[ ] All dry pipe systems are equipped with auxiliary drains located at all low points and are clearly marked.

[ ] All system components are clearly marked.

The contractor responsible for work within this section or the general contractor shall sign below and return this form through the approved channel as an indication that all the above criteria have been completed per the contract specifications.

On-Site Cx Scope Meeting

- Discuss roles and responsibilities, set cooperative tone.
- Distribute Contractor Pre-Cx forms.
- Distribute commissioning plan with examples of physical inspection and functional test forms.
- Coordinate with control contractor and other specialty system contractors.

Physical Inspection

- Readiness for functional test.
- Maintainability issues.
- Specification compliance.
- Documented in observations & deficiencies report and in final report.

Sample Physical Inspection

Air Handling Units

AHU-1

[ ] Unit is accessible for service.
[ ] Equipment labels are installed per specifications.
[ ] Filters are installed and accessible.
[ ] Control wiring and devices are installed.
[ ] Supply power is installed and disconnect is accessible.
[ ] Overloads and/or fusing is appropriate.
[ ] Damper actuators are installed.
[ ] Discharge air, return air and mixed air temperature sensors are installed.
[ ] All ductwork is installed.
[ ] Piping, valves and insulation are complete.
[ ] Lubrication has been applied.
[ ] Smoke dampers are installed, have access panels and are normally open.

[ ] Unit installation is complete and ready for functional testing.

Functional Test

- Systematic testing of each system in all operational modes.
- Some random testing including air balancing checks.
- Documented in observations & deficiencies report and in final report.

Occupied Modes

Sample Functional Test

Air Handling Unit Occupied Mode Tests

1. Place the system in the occupied mode.
2. Verify by physical inspection that the return air fan only starts first and the supply air fan starts, the dampers modulate and the heating valve modulates after a 15 second delay.
3. Verify BAS displays the correct status for the air handling units.

 Return fan starts first, 15 second delay for other components.

	AHU-1	
Supply Fan	ON	
Return Fan	ON	
SAT	55 F	
RAT		
MAT		
OSA Damper		
RA Damper		
Exhaust Damper		
P Filter Status		
B Filter Status		
Heating Valve %		

4. Verify hot water loop is up to temperature and record loop temperatures.
5. Supply Air Temperature Control: Set the discharge air temperature set point to create no demand for heating, record values, then increase set point and verify heating valve responds and unit controls to new set point.

Heating loop supply temperature start of tests_____ °F
Heating loop return temperature start of tests_____ °F

Unit	SP1	SAT1	SP2	SAT2	Controls?
AHU-1					

Project Close Out

- Verify specified training is provided.
- Review contractor as-builts and O&M manuals.
- Final commissioning report.
- Possible seasonal testing and additional owner support through warranty period.

Rules and Codes

Washington Administrative Codes (WAC) Regarding New School Construction

- Educational Specifications (WAC 180-29-050)
- Architect-Engineer (WAC 180-29-055)
- Energy Conservation Report (WAC 180-29-060)
- Value Engineering (WAC 180-29-065) ⟵
- Constructability Review (WAC 180-29-066) ⟵
- Building Commissioning (WAC 180-29-067) ⟵
- Construction Management (WAC 180-29-068) ⟵

WAC Rules

- VE/CR/CX required on all buildings greater than 50K square feet.
- Optional between 15K and 50K.
- Prior to opening bids, submit copy of the VE and CR reports approved by the school board.
- School board approval (a resolution) of the final commissioning report to get retainage release.

State Provided Funding

- The maximum amount of assistance for each component shall be the state matching percentage multiplied by the greater of:
- 2/5 of 1 % of the area cost allowance multiplied by the square foot area, or $20,000

WAC Definition of Commissioning

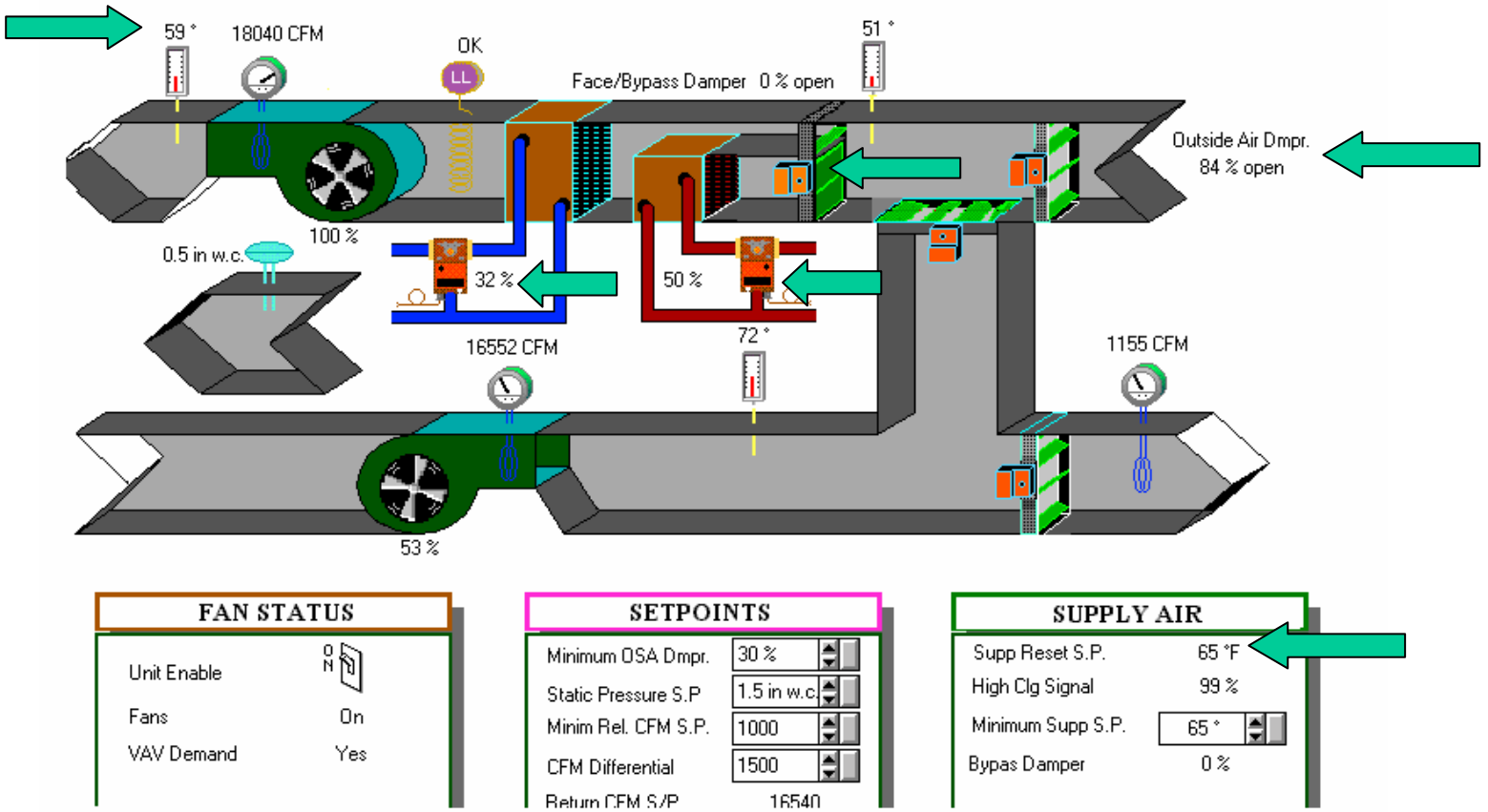
- The process of verifying that the installation and performance of selected building systems meet or exceed the specified design criteria and therefore satisfy the design intent.
- It shall include physical inspection, functional performance testing, listing of deficiencies and a final commissioning report.

WAC Rules on Commissioning

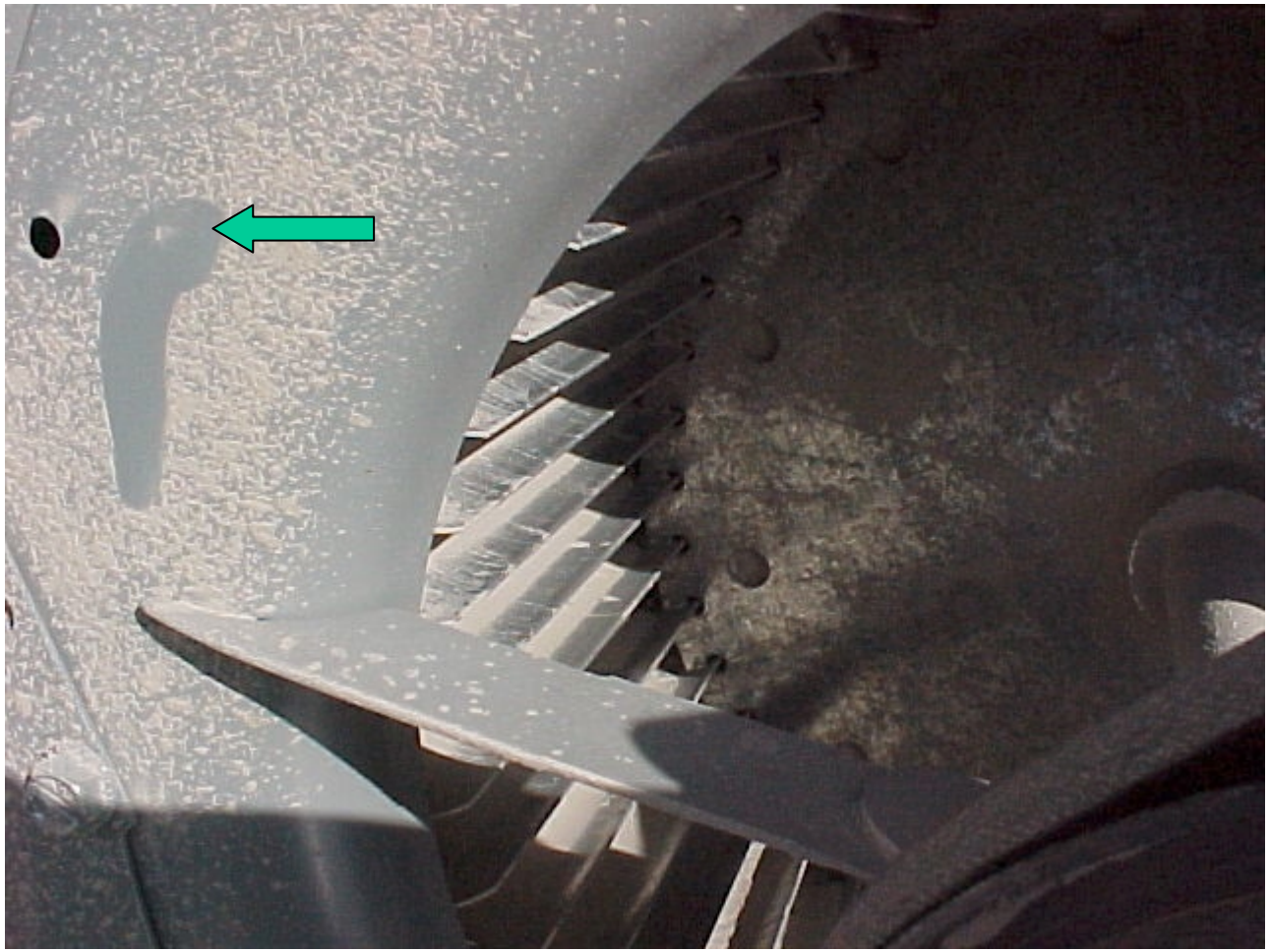
- No specified team make-up.
- Must conform to Building Commissioning Association (BCA) Essential Attributes.
- Cx Agent cannot be financially or otherwise associated with design or construction team.

Commissioning Findings

Controls and Sequence of Operations

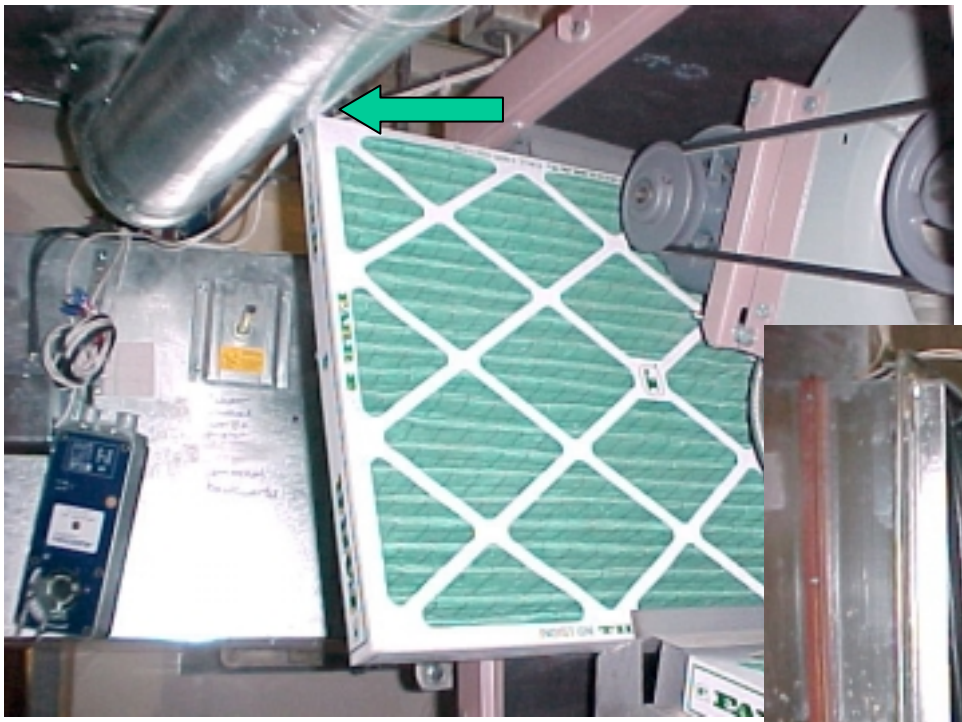


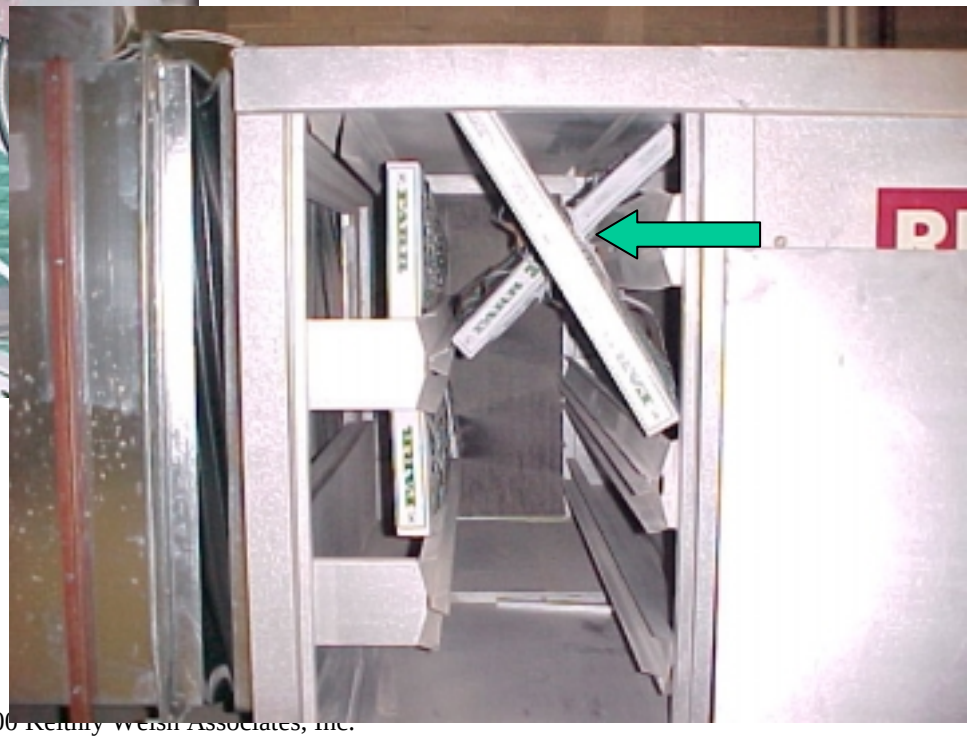
Dirt & Construction Debris



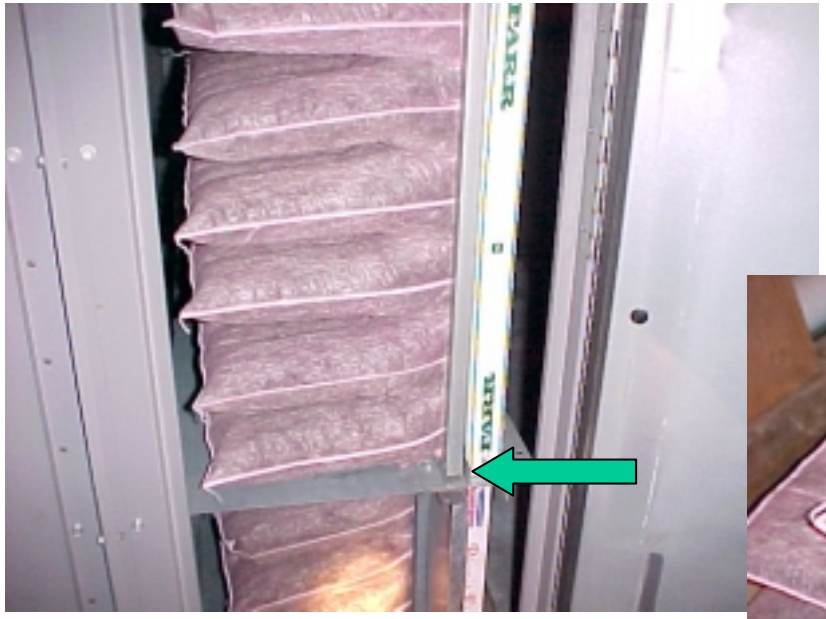
Blown Duct Board Hidden Above Ceiling

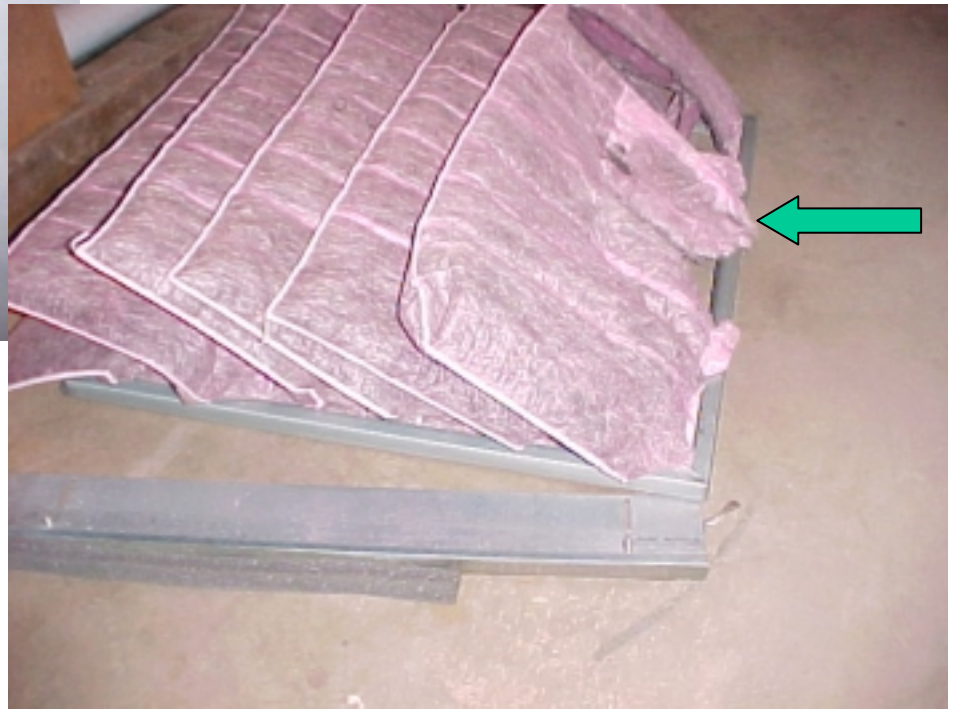
Filter Problems



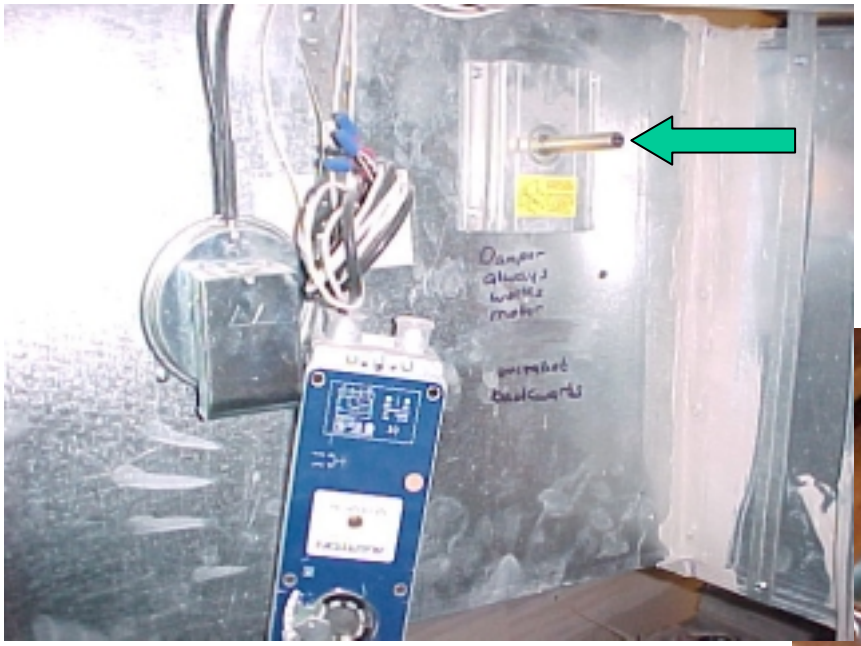


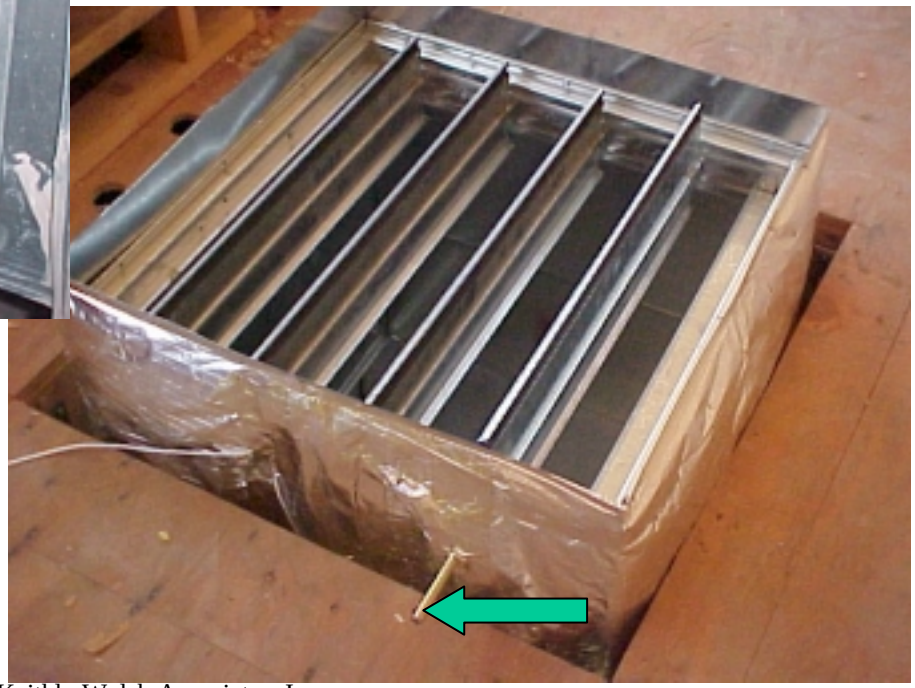
More Filter Problems





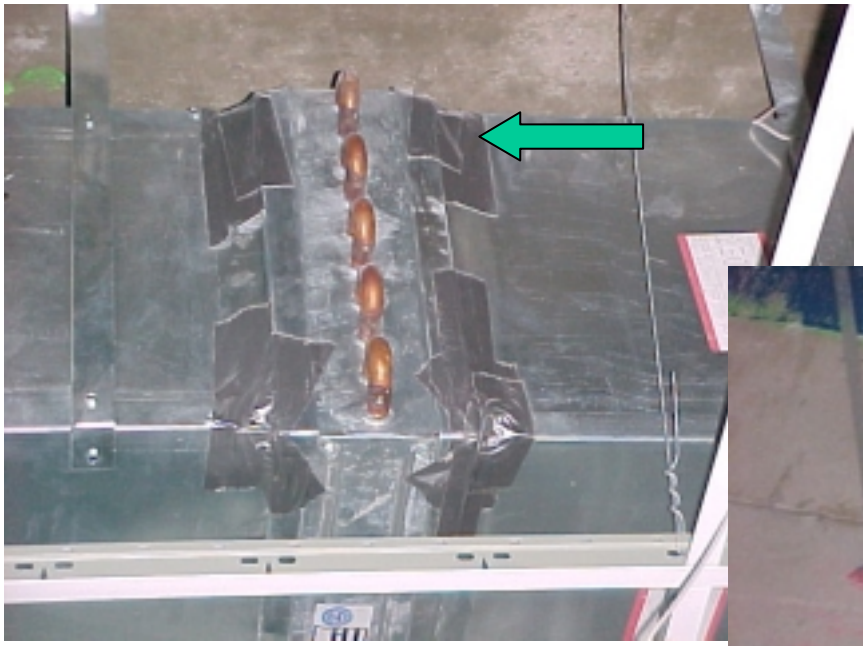
Actuators Missing or Fallen Off

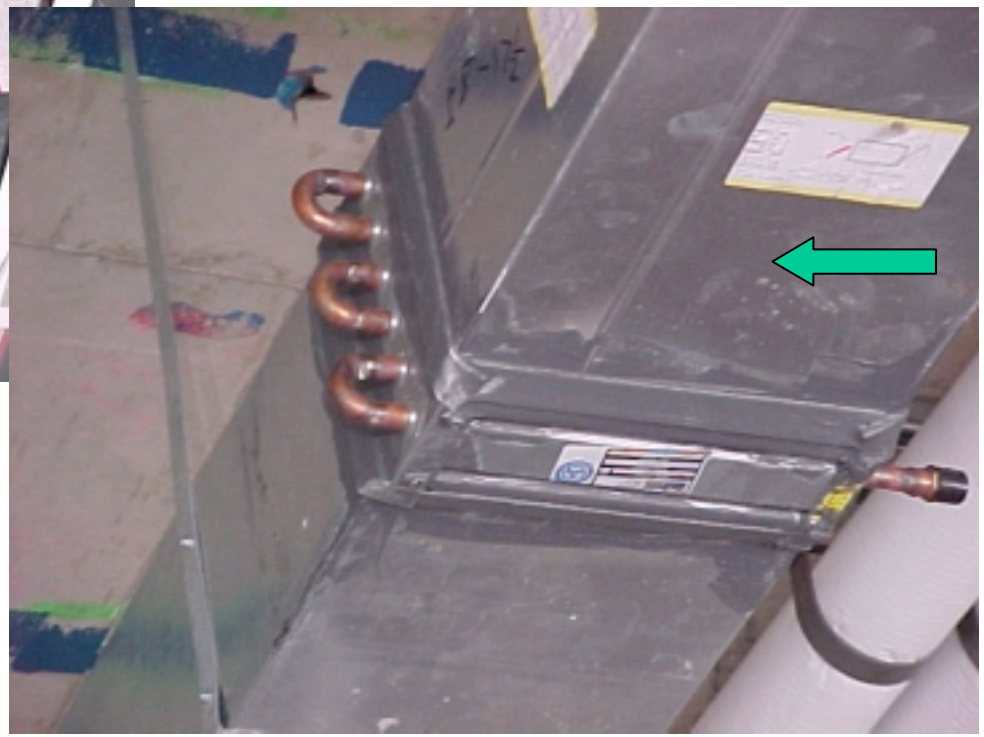




Improper Condensate Drains

Duct Tape - No Access Hatches





Redundant Sensors

Coordination and Interference

Fire Protection Issues

- Screw threaded through fire damper blade
- Fire damper not wired
- Tamper switches not operational or report wrong location
- Alarm points not reporting correct location
- Fire/Smoke control zones not defined correctly
- Inoperable smoke evacuation systems

Result of not coordinating HVAC & Fire Dampers

Summary

- Commissioning needs (and will be) done at some level on every project.
- The cost of third party commissioning will usually pay for itself.
- Select a commissioning consultant early to assist in the integration process.
- Many states and municipalities are integrating commissioning requirements into their processes.